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# The Effect Of Staff Development Of Teachers In The Use Of Higher Order Questioning Strategies On Third Grade Students' Rubric Science Assessment Performance

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THE EFFECT OF STAFF DEVELOPMENT OF TEACHERS IN THE USE OF  
HIGHER ORDER QUESTIONING STRATEGIES  
ON THIRD GRADE STUDENTS'  
RUBRIC SCIENCE ASSESSMENT PERFORMANCE

BY

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requirements of the degree of Doctor of Education  
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## ABSTRACT

### The Effect of Staff Development of Teachers in the Use of Higher Order Questioning Strategies on Third Grade Students' Rubric Science Assessment Performance

The focus of this study was the staff development of third grade teachers in the use of higher-order questions. The study investigated how this training affected the performance of students in science. A true experimental design was used. This design allowed the researcher to examine the effects of the staff training on the performance of third graders who had been instructed by teachers trained in the use of higher-order questions compared to the performance of third graders who were taught by staff members who had not received the training.

The performance of students was assessed by an open-ended question, which was scored by the use of a rubric. This type of question requires higher-order thinking on the part of the students (Bloom, 1956). In this way, the effects of strategic questioning practices of staff members during science instruction could be examined by looking at the responses of students to the open-ended question.

The results of this study included a change in the use of higher order questions by staff members in science instruction. Randomly selected matched groups of third graders responses on a rubric assessment of an open-ended question administered by third grade teachers produced significantly different frequencies of rubric scores between experimental and control groups. The use of a chi-square analysis of the differences in frequencies between experimental and control responses produced a p value  $<.001$  indicating that the differences in results was not random or occurring by chance.

There are a number of implications from this study. Pupil performance can be influenced as a result of staff development. Staff development can directly affect the instructional practices of teachers. The instructional practices of teachers do, in turn, have a significant and measurable impact on the performance of students.

A further implication of this study is the need for direct classroom intervention by a knowledgeable individual to help guide teachers with staff development implementations and to insure these new practices are successfully and routinely utilized in their classroom instruction. The role of the building principal in this regard becomes extremely important.

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## Dedication

This work is dedicated to my husband, Fred, my children, Erin, Brendan, and Bridget, and to my parents, James and Regina.

Fred's unconditional love and support were the foundation upon which this work was built. Without these, it would not have been possible for this document and my degree to become a reality. With them, nothing has been impossible. Should the words on this page ever become destroyed or disappear in some way, they will always be written indelibly upon my heart.

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## TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	iii
DEDICATION.....	v
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
 I INTRODUCTION.....	 1
Context of the Problem.....	1
The Background of the Problem.....	8
The Purpose of the Study.....	12
Hypothesis.....	12
Variables.....	12
Definition of Terms.....	13
Staff Development.....	13
Higher-Order Thinking Skills.....	13
Higher-Order Questioning Strategies.....	13
Limitations of the Study.....	14
The Significance of the Study.....	14
 II REVIEW OF RELATED LITERATURE.....	 16
The Historical Background of Staff Development.....	17
General Staff Development.....	19
Science Staff Development.....	21
Theory and Policy on Staff Development.....	25
Literature Review Conclusion.....	29
 III RESEARCH DESIGN, PROCEDURE, AND DATA ANALYSIS.....	 30
Research Design.....	30
Procedure.....	31
Subjects.....	31
Intervention - Workshop.....	31
Pre-Workshop Observation.....	33
Description of Workshop.....	33
Student Assessment.....	34
Follow-up Workshop.....	35
Data Analysis.....	35
 IV RESULTS.....	 37
Qualitative Results.....	37
Quantitative Results.....	45

Summary.....	53
V SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS.....	55
Summary.....	55
Introduction.....	55
Conclusions.....	56
Hypothesis.....	56
Discussion of the Qualitative Data.....	56
Discussion of the Quantitative Data.....	58
Interpretation of the Results.....	60
Recommendations.....	61
Implications of the Study.....	61
Limitations of the Study and Recommendations for Future Research.....	64
REFERENCES.....	66
APPENDICES.....	76
Appendix A. Teacher Questionnaire.....	77
Appendix B. Question Asking Tally Sheet.....	79
Appendix C. Cover Sheet for Third Grade Open-Ended Question Open-Ended Question and Rubric.....	81
Appendix D. Principal, Teacher, Parent, Student Letters, and Consent Forms.....	84

## LIST OF TABLES

Table 1	Results of Pre-Workshop Teacher Observations.....	38
Table 2	Results of Teacher Questionnaire on Educational and Teaching Background.....	41
Table 3	Question Asking Tally Sheet Frequencies for the Experimental Group of Teachers.....	44
Table 4	Comparison of Frequencies of Rubric Scores for Control versus Experimental Groups.....	50
Table 5	Chi-square Analysis of Individual Rubric Scores for the Experimental versus the Control Group of Students.....	52
Table 6	Chi-square analysis of High and Low Rubric Scores for the Experimental versus the Control Group of Students.....	54

## LIST OF FIGURES

Figure 1	Frequencies of rubric scores for control student responses.....	48
Figure 2	Frequencies of rubric scores for experimental student responses...	49

## Chapter I

### INTRODUCTION

#### Context of the Problem

Science requires a specific kind of thought process involving higher order thinking skills. Theories of science were and are derived from a process of logic known as the scientific method, which incorporates inference and deduction to make the journey from the unknown to information backed by investigative research.

Children possess a naturally insatiable curiosity. Exploration and discovery are native to their acquisition of scientific knowledge. They possess a tolerance for ambiguity and a resilience to continue experimenting when one possibility becomes a dead end. Thus, for them, science is an engaging and exciting journey.

Adults, and elementary teachers in particular, however, do not instinctively approach science this way. They tend to rely on fact acquisition, which requires rote memorization as the methodology. For students to learn science best, they need to experience the process through which scientists discover outcome-based knowledge. Discovery-based learning utilizing higher order thinking skills places the responsibility for learning on the student, not the teacher. It also enables the child to learn in the style or styles most effective for him or her.

In 1927, a committee organized by the American Association for the Advancement of Science issued a report: On the Place of Science in Education. The report stated that teaching the scientific method should be an integral goal of science education. The Thirty-First Yearbook, Part I of the National Society of Education, "A Program for Teaching Science" (1932) dealt with the issue of science instruction. It

stated that the aim of science teaching is to expose students to problem solving situations, which must be the core of the curriculum. The memorization of unrelated facts was not recommended. This emphasis on the scientific method underscores the use of answering questions as a fundamental part of science education.

During the 1960s, the process approach in science education was developed. Robert Gagne (1965), a psychologist, was instrumental in constructing the process hierarchy. He said about this process:

The goal of this approach is not an accumulation of knowledge about any particular domain. However, a variety of content is used to support the learning of process skills...The sixth grader who has learned science processes in this manner should be capable of studying science in the higher grades in a way not now possible, i.e., said student will be able to learn about any science, presented in accordance with its theoretical structure, in far less time than would otherwise be required. (p. 25)

This requires the teacher to be more of a guide or facilitator to the active learning process of the student. One invaluable tool the teacher must utilize in this environment is a highly developed questioning ability, in other words, asking the right higher-order questions to help focus the learner.

Constructivism is also important in the discussion of elementary science teaching. It focuses on how individuals construct meaning. There are two main principles in constructivism. Knowledge is actively received, interpreted, and built by the learner (von Glaserfeld, 1987). Most educational practice contradicts this first principle (Wheatley,

1991). The second principle demonstrates that the function of thinking and cognition is adaptive and helps to organize the experiential world (von Glaserfeld, 1987). The affective domain influences the learning process. The social domain influences the development of people and learners who then construct meaning of cognitive situations in response to experiences in this social context (Ernest, 1994).

There are two areas defined as part of constructivism in cognitive research that lend to its usefulness in science education. Constructivism begins with schemata as the building blocks of cognition (Rumelhart, 1980). The first point in the process is what the learner already knows. Learning depends upon the relationship the learner forms by connecting the new information to existing knowledge (Dochy & Bouwens, 1990).

Secondly, there is the concept of metacognition. This is the learner's "...ability to think about thinking, to be consciously aware of oneself as a problem solver, and to monitor and control one's mental processing" (Bruer, 1995, p. 68).

Constructivist classrooms encourage learners to ask questions and present problems as a basis for learning (Peixoto, 1993). When used in an elementary science classroom this use of questions provides the opportunity for discussion, investigation and organization of scientific ideas and phenomena. Driver (1988) stated that such a classroom produces student-determined learning tasks, which allow learning to exist as an active process. Learners adapt initial concepts and adopt new ones as opposed to taking in teacher generated ideas. This results in active learning (Smith & Anderson, 1984). Cookbook learning does not contribute to the essence and the meaning of the new ideas. Constructivist learning is the product of students developing new meanings for



concepts as a result of making sense of their own experiences (Loucks-Horsley, Kapitan, Carlson, Kuerbis, Clark, Melle, Sachse, & Walton, 1990).

There is a foundation for constructivism in science education. Students first come to science instruction with conceptual understanding of science concepts, which are misconceptions from the ideas generally held by the scientific community. These "misconceptions" or "naïve conceptions" are very important, significant, and useful to the child and to the child as learner (Driver & Erickson, 1983; Driver & Oldham, 1986; Wittrock, 1985). These misconceptions are based upon the differences between personal experiences of the child and the scientific concept (Novak & Nussbaum, 1988). Traditional school instruction tends to reinforce these "naïve conceptions" since it does not provide the tools to transform these concepts (Gabel, 1994; Wittrock, 1985).

Constructivism focuses on the relationship between the knower or learner and the natural world. The knower constructs useful knowledge and adapts it to a complex and changing world (Staver, 1995). In this way, the previous experience of the learner is the framework for making sense of the world around him (Roth, 1972; von Glassersfeld, 1984). Individuals assimilate or accommodate new learning on the basis of previous frameworks of understanding (Piaget, 1972, 1980).

Questioning strategies are a big part of the constructivist teaching process. From birth, the brain has the potential to assimilate a large variety of stimuli. Over time, the human brain develops mental routines or patterns. This practice is called neural pruning. This prevents people from having to interpret the same stimuli over and over again each time they encounter them. However, good education involves extending neural networks.

...it is nevertheless advantageous to be able to attend, selectively, to many stimuli-to overcome our neural pruning. In biological terms, we might call this 'extending the neural network' or, in more poetic terms, 'neural branching'-the opposite of neural pruning. Current research indicates that this type of significant 'brainwork' strengthens the brain-creating more synapses between nerve cells-just as exercise builds muscle tissue."

(Cardellichio & Field, 1997, p.33)

Education, for the most part, tends to encourage learners to look for content, an extension of this process of neural pruning.

Good teaching requires that students have the opportunity to select and assimilate enough data to force them to challenge misconceptions and to create strong, accurate conceptions.

They cannot do this if the curriculum or the methodology or the structure of the school is so rigid that students experience only the presentation of data without the opportunity to make sense of it. This kind of teaching only accelerates neural pruning where we want to encourage neural branching....

Underlying...is the assumption that questioning is a far more powerful way to encourage neural branching than is explication or narration. (Cardellichio & Field, 1997, p. 34)

Research suggests that aspects of teaching effectiveness make the difference in how students perform. Successful teachers tend to be those who employ a range of teaching strategies and interactive styles, not a single, rigid approach. Effective teachers adjust their teaching style to fit the needs of their learners. They utilize different instructional goals, topics, and methods (Doyle, 1985). The research further demonstrates that teachers' abilities to structure material, ask higher order questions, use student ideas, and probe student comments have also been found to be important variables in what students learn (Darling-Hammond, Wise, & Pease, 1983; Good & Brophy, 1986; Rosenshine & Furst, 1973).

Linda Darling-Hammond (1997) found that effective teaching is essential in the process of student learning. Quality professional development is an integral component of high performance student achievement.

Nonetheless, the findings of this study, in conjunction with a number of other studies in recent years, suggest that states interested in improving student achievement may be well-advised to attend, at least in part, to the preparation and qualifications of the teachers they hire and retain in the profession. It stands to reason that student learning should be enhanced by the efforts of teachers who are more knowledgeable in their field and are skillful at teaching it to others. Substantial evidence from prior reform efforts indicates that changes in course taking, curriculum content, testing, or textbooks make little difference if teachers do not know how to use these tools well and how to diagnose their students' learning needs....this research indicates that the

effects of well-prepared teachers on student achievement can be stronger than the influences of student background factors, such as poverty, language background, and minority status (Darling-Hammond, 2000, p. 28).

The problem is how to train primary grade teachers. The specific strategy that primary staff members need to learn is how to become effective questioners. Staff development takes on a greater significance in light of this difficulty. As Dennis Sparks (1997) describes it, "For too many teachers, staff development is a demeaning, mind-numbing experience in which they passively 'sit and get'. As one observer put it, 'I hope I die during an inservice session, because the transition between life and death would be so subtle (p. 21).'"

The type of staff development, which is necessary to improve student achievement, is not the type of inservice where elementary teachers just attend a workshop to learn how to perform some catchy little activity to be used when teaching a particular concept. The inservice necessary to improve pupil performance is one in which staff members are trained in the use of a precision instrument, such as the use of higher order questions, which heightens the significance and expands the learning potential of all activities and concepts, not just one particular topic.

Examining and assessing the link between the professional development of teachers and its relationship to pupil achievement is fundamental to understanding how school systems might effectively alter teacher practice.

Someone once noted that every system is specifically designed to produce the results it gets. The interconnectedness of all parts of the

educational system means that classrooms, schools, and school districts are tied together in a web of relationships in which decisions and actions in any part affect the other parts and the system as a whole. In other words, the systems and structures within which teachers work exert a powerful influence on their performance and that of their schools (Sparks, 1997, p. 22).

This concept may also be extended to include the role of the building principal as a functioning part of the "systems and structures within which teachers work", and "exert a powerful influence on their performance and that of their schools (Sparks, 1997, p.22)."

### Background of the Problem

Traditionally, staff development has not been evaluated by student achievement in the researcher's school system. In the past, teachers were provided workshop experiences by the district. It was then assumed that these teachers returned to their respective classrooms and effectively implemented the strategies and practices acquired through the staff development. However, staff development for this school system took on a new level of significance when the State of New Jersey implemented Core Curriculum Content Standards in the fourth, eighth and eleventh grades. This heightened the need for the researcher's district to look at the connection between staff development and pupil performance in the areas of these core proficiencies. The standards involved new content areas and skill areas that teachers are responsible for presenting to students. Students needed to master the new material for the New Jersey State Assessments, the

fourth grade Elementary School Proficiency Assessment (ESPA), the Grade Eight Proficiency Assessment (GEPA), and the High School Proficiency Assessment (HSPA).

Among the subjects which elementary teachers were required to prepare fourth graders for was science. The science scores have counted as part of the ESPA and have been reported in New Jersey's largest newspaper, the Star Ledger since May 1999. With this end result in mind, the district needed to provide staff development opportunities for elementary staff to enhance pupil learning outcomes in the area of science.

The subject district began to look for assessment measures for pupil progress to determine the effectiveness of teacher methodology in the classroom. An emphasis was placed upon correlating outcome-based indicators by students to alter and adjust curriculum, technology, teacher methodology and staff development. The use of research and data interpretation acquired a new and heightened significance. These kinds of indicators of pupil performance, which would ultimately serve as predictors of success on the ESPA, became extremely important to the district.

The type of instruction that the district was seeking was a level of teaching that encouraged the use of higher-order thinking skills on the part of the teaching staff. Among the difficulties identified by the district was the practice of the elementary staff to teach to the content of the current standardized assessment used in grades prior to the fourth. Unfortunately, the content of this assessment instrument did not parallel the proficiencies assessed by the ESPA. This mindset on the part of these grade level educators involved the use of "skill and drill" education to cram the topics covered by the standardized test into their students to insure optimum performance. Ultimately, students were experiencing little higher-order learning activities in these grade levels. Therefore,

the bulk of the responsibility for the type of learning that focused on a standards-based curriculum became the province of the fourth grade teachers. This increased pressure to have fourth graders ready for the ESPA was becoming an overwhelming task for the fourth grade staff.

As the district assessed its instructional processes, it became clear that teachers in the grade levels prior to the fourth grade would need training in instruction that emphasized the use of higher-order thinking skills. It was decided that all third grade teachers would be the first group to receive workshops in this type of process education. What was identified, in particular, was the need to increase the use of precise questioning strategies by these staff members. The emphasis in instruction needed to shift from the staff providing content and expecting students to remember it to an instructional process encouraging children to uncover, examine and internalize that same knowledge for themselves. Asking higher-order questions of students and allowing them to infer and deduct the answers became the logical and practical place to begin.

Benjamin Bloom (1956) created a taxonomy for categorizing the level of abstraction of questions that commonly occur in educational settings. This taxonomy sets up a useful series of steps, which identify increasing degrees of abstraction. Training elementary teachers in the use of this taxonomy would provide a useful tool for staff members to identify which type of questions lead to higher level thinking and responses in students.

Upon examination of Benjamin Bloom's cognitive domain contained in his Taxonomy of Educational Objectives, teachers are reminded that the classification levels of the cognitive domain,

namely knowledge, comprehension, and application, are skills of recall and recognition, whereas analysis, synthesis, and evaluation comprise higher energy intellectual skills.... Because teachers' questions are used to solicit learner participation, their questions should serve as quality demonstrations that lead to the enhancement of students' ability to self-interrogate at all levels of Bloom's taxonomy (Williamson, 1998, p. 31).

Bloom's taxonomy (1956) provides teachers with a roadmap to guide them in providing instruction that prompts higher-order thinking in students. The six levels of Bloom's taxonomy (1956) are as follows: (a.) knowledge, where question words such as list, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where are used, (b.) comprehension, where question words such as summarize, describe, interpret, predict, associate, distinguish, estimate, differentiate, discuss, extend, and (c.) application, where question words such as apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover are used. These categories represent convergent, single answer responses involved in lower-order thinking:

Divergent, multiple answer responses involved in higher-order thinking are represented in the following three categories of Bloom's taxonomy (1956): (d.) analysis, categorized by the use of question words such as: analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer, (e.) synthesis, categorized by the use of question words such as: combine,



integrate, modify, rearrange, substitute, plan, create, design, invent, what if?, compose, formulate, prepare, generalize, rewrite, and (f.) evaluation, categorized by the use of question words such as: assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize. Once staff members were instructed in the use of these levels of questions, and implemented it in their classrooms, it would be important to assess the level of performance among students instructed with this style of teaching.

#### Purpose of the Study

The purpose of this study was to determine if there was a measurable difference on a rubric assessment in science of students who had been instructed by teachers trained in the use of higher-order questions as compared to students whose teachers had not had this training and had not received this level and type of instruction.

#### Hypothesis

The null hypothesis is that there will be no statistically significant difference between (a.) the performance of students on an open-ended, rubric-assessed question who had been instructed by teachers who received training in the use of higher-order questions and (b.) the performance of students on an open-ended rubric-assessed question who had been instructed by teachers who had not received the training.

#### Variables

The predictor variable in this study was the training of teachers in the use of higher-order questions. The criterion variable was the assessment of third graders on an open-ended, rubric-scored question on plants.

## Definition of Terms

Definition of terms used in this study are provided to clarify their meaning as they relate to this study.

### Staff Development

The term staff development in this study refers to training through which teachers were instructed in processes that relate to instruction. This training was given outside of the classroom with the understanding that they would utilize the practice in their classroom instruction following the workshop. The operational definition of staff development in this study is narrowed to a workshop given to third grade teachers in the area of higher-order thinking strategies.

### Higher-Order Thinking Skills

Thinking skills refer to processes that the mind goes through in the process of comprehension. Certain functions are on a lower order and are simple processes such as memorizing a list of information and repeating the information. With higher-order thinking skills, a process of integrating various thought processes is involved. This would involve a process such as synthesizing information and developing a conclusion for why something may have occurred (Bloom, 1978). The operational definition of higher-order thinking skills in this study refers to the use of a rubric analysis of specific levels of higher-order thinking as indicated by Bloom (1978).

### Higher-Order Questioning Strategies

Higher-order questioning strategies involve the use of questions designed to encourage higher-order thinking. When a teacher uses higher-order questioning strategies, he or she is acting as a facilitator and guiding a student through the process of

looking at information, analyzing it and formulating conclusions about the information. The process is designed to foster the behavior independently in learners without the intervention of the facilitator. This would lead to critical thinking on the part of the learner and a more thorough understanding of information than mere memorization of facts.

#### Limitations of the Study

Limitations of the study included: (a.) the study was conducted in a limited time frame and the effect of the treatment over time was not studied. (b.) The researcher conducted the workshop and the assessment. Therefore, the possibility for bias exists. (c.) A non-standardized instructional procedure was used in the form of a rubric analysis. (d.) The time of day for the teacher training varied with some teachers receiving training in the morning and some in the afternoon might affect the learning ability of some teachers.

#### The Significance of the Study

With school systems needing to train staff in instructional strategies designed to meet new and intricate performance standards, effective staff development becomes essential. Schools need a concrete method of assessing the effects of professional development of teachers on the achievement of students. Therefore, a study, which examines the effectiveness of staff development as measured by pupil performance, meets these needs.

The outcome of this research will benefit students because:

It will heighten teachers' awareness of the direct relationship between their instructional practices and the ultimate understanding, internalization, and application of knowledge by students.

When teachers are trained to be more aware of their specific questioning strategies in the classroom as a direct relationship to how children learn by assessing their performance in the areas of higher-order thinking skills, teachers can modify, adjust, customize, and alter their instruction.

This increased awareness of staff will lead to the increased learning potential of individual students.

The everyday classroom instruction of teachers can be more effective if they are able adequately to assess the progress of students on an ongoing basis and in an in-depth way.

## Chapter II

### REVIEW OF RELATED LITERATURE

The purpose of this review of the literature is to provide an overview of research on staff development. The history of staff development and staff development specifically in elementary education and in science instruction have been explored in an attempt to underscore how this process relates to the performance of students in the elementary classroom. Current staff development theory and policy are presented to lay a theoretical framework to support this research study. This chapter is designed as a critical analysis of existing research and theory in the field of staff development and to provide a compelling argument for this research study.

Dr. Charles Achilles, a researcher and professor of education at Eastern Michigan University, addressed the issue of staff development as it relates to pupil performance during a lecture on July 12, 2000, at Seton Hall University, South Orange, New Jersey, for the Executive Doctoral Program in Educational Administration and Supervision. Dr. Achilles is one of the researchers and authors of the Tennessee STAR study on class size reduction. He indicated that there is no research linking the specific staff development activities of teachers directly with the performance of students in their classroom; therefore, there is a great need for research in this area.

This information by an expert and highly noted researcher in the field of education provides the most compelling reason in this literature search for pursuing this line of research, which connects staff development to pupil performance. Effective staff development and effective implementation of staff development in the classroom has an

effect on children. Looking at a direct connection between the two in a controlled research situation is missing from the literature and necessary for the field of education.

After an extensive search of related literature, no research studies on the particular variables investigated in this study were found. Therefore the researcher delved into the literature on elementary and science staff development, as well as, the historical and theoretical background. The following information as it relates to the topic of staff development is presented.

### **The Historical Background of Staff Development**

The specific event, which precipitated increased math and science staff development of teachers in school systems, was the release of A Nation At Risk (National Commission on Excellence in Education, 1983) report in April of 1983. In the wake of the Sputnik challenge, the United States Secretary of Education, T. H. Bell, created the National Commission on Excellence in Education on August 26, 1981. This commission was empowered to examine the quality of education in the United States since the Russians had beaten America into space. The results of this investigation produced a dire treatise on the condition of education in America. One of the recommendations of this report was the establishment of professional development for teachers in the United States.

The National Education Goals were adopted by the nation's governors in 1990. In March 1994, the "Goals 2000: Educate America Act" made the National Education Goals federal policy and they became the guiding principles for a fundamental restructuring of the U.S. public education system. These goals have created a climate of education

reform and have demanded improved professional development for American educators in elementary and secondary schools.

In 1995, The Third International Math and Science Study (TIMSS) (The International Association for the Evaluation of Educational Achievement, 1995) was released. This study compared the achievement of fourth, eighth and twelfth graders in math and science from a multitude of countries around the world, including the United States. As the grade levels increased, the results of American students decreased. Berliner and Biddle (1995) point out that American students tend to score below the mean internationally. Some states score higher and some states score lower. Linda Darling-Hammond (1997) points out that in math and in physical science, U.S. students scored much more poorly. Eighth graders in America ranked 18<sup>th</sup> out of 25 countries that met the guidelines for participation in the TIMSS study in math and ranked 17<sup>th</sup> among the 25 countries participating in TIMSS. Twelfth graders fared worse. Gilbert A. Valverde and William H. Schmidt (1997), associate and executive directors of the U.S. National Research Center for the Third International Math and Science Study, respectively, included in their recommendations for increased performance of American students in math and science that staff development be a regular part of the professional development of teachers.

This information demonstrates a compelling implication from comparative research on pupil performance in math and science that improved teacher practice is essential to improved student results. A specific mandate was forwarded as a result of this research that quality staff development for teachers in the areas of math and science be provided in United States schools. The next portion of this literature review

investigates how this mandate has been implemented in public schools in America to date.

### General Staff Development

Seventy-one research studies on staff development have been performed since the release of A Nation At Risk (1983). None of these studies directly link staff development of teachers to pupil performance. The nature of the vast majority of these works deal with issues of teacher efficacy, the nature of good staff development, problems of staff development delivery and implementation, and various assessment studies of particular staff development models. The following studies of general staff development relate the most to the present study.

Marianne Betkouski Barnes and Lehman W. Barnes (1989) researched the success of in-service. They emphasized teacher concept formation utilizing question-asking behavior. This was used as a vehicle for teachers' to confront their own misconceptions regarding specific science concepts. Through the use of quantitative and qualitative data, this study concluded that the institute conducted in this study was successful from the standpoint that teachers confronted many of their own misconceptions. Affectively, teacher response was positive, and they indicated that they had benefited from the question-asking strategies. The limitation of the Barnes and Barnes (1989) study is that it deals mainly with teacher efficacy. Question-asking behavior is designed to have teachers look at their own misconceptions. The study does not deal with teacher use of higher-order questions in the classroom setting and does not look at all at the influence of these questions on pupil performance.



Bull and Barry (1994), did a study on the most frequently used form of professional development. They looked at the use of occasional workshops conducted by outside consultants. They found that this was widely determined to be ineffective. The study itself concentrated on professional development and its connection to teacher time. While the study itself does not connect teacher staff development to pupil performance, it underscores that traditional methods of staff development are not effective and do little to enhance student learning.

Kenneth W. Miller (1992, p.12) studied the effectiveness of a model for inservice. In the research report Miller notes that, "In spite of decades of research and staff development attempts, few efforts at reforming education in our schools have been successful." The model discussed was the Triad Model. The study fails to link the inservice to pupil performance; it does, however, provide a rationale for a means to assess the success of staff development due to the documented lack of effectiveness of inservice despite decades of research.

There is a growing body of research suggesting that the quality of schools makes a difference in student performance and a substantial part of that research attributes the source of this difference in pupil performance to the teacher. Several studies have looked at teacher effects at the classroom level. They used the Tennessee Value-Added Assessment System and a similar database in Dallas, Texas. These studies found that differential teacher effectiveness is a strong determinant of differences in student learning. This teacher differential far outweighs factors such as class size differences or the heterogeneous or homogeneous make-up of the classroom (Rivers & Sanders, 1996; Horn, Sanders,

& Wright, 1997; Jordan, Mendro, & Weersinghe, 1997). Students who were taught by a series of ineffective teachers had significantly lower achievement and gains in achievement than students who had been taught by several highly effective teachers in a row (Rivers & Sanders, 1996). These studies provide a substantial rationale for this research study as they demonstrate a direct connection between the practices of teachers and the performance of students.

Jeanie Weathersby and Steve Harkreader (1999) found a clear difference between the approach to staff development in higher and lower achieving schools. Their study examined differences in factors such as decision-making processes, content, focus, providers, strategies for providing time, format and delivery, teachers' views on support, leadership at the school, role of the district office, and training of leadership in guiding staff development. While this study does examine staff development in general and its differences in specific variables between higher and lower performing schools, there is no direct link made between pupil achievement and the staff development of teachers.

#### Science Staff Development

Eighteen research studies on staff development have been performed since the release of A Nation At Risk (N.C.E.E., 1983). Although there is a closer look at student assessment in the body of the science staff development literature, not one of these studies link science staff development directly to pupil performance. As with the general staff development studies, the vast majority of the science literature deals with issues of teacher efficacy, the nature of effective science staff development, problems of science staff development delivery and implementation, science cognition and various assessment

studies of particular staff development models. The following studies of science staff development relate the most to this research study.

Judith A. Burry-Stock and Rebecca L. Oxford (1994) examined the Expert Science Teaching Education Evaluation Model (ESTEEM) under the aegis of the Center for Research on Educational Accountability and Teacher Evaluation (CREATE), which was funded by the U.S. Office of Educational Research and Improvement (OERI). They looked at the model, its development, theoretical premise, and research from 1990 through 1993. The major goals of the project was to define the characteristics of expert science teaching, develop instruments to assess expert science teaching based on these characteristics, and develop an expert teaching evaluation model to improve science instruction. The most obvious oversight in this early model was the complete omission of students from any part of the study and discussion.

New Mexico's Systemic Initiative in Math and Science Education (SIMSE) (A.D.A., 1995) relied on the use of field specialists and summer institutes to improve math and science instruction. Data were collected through the use of teacher journals and surveys. Looking at scores on standardized tests, which would not necessarily have aligned with the curriculum, assessed student performance. There was no experimental design and the evaluation was over the entire state of New Mexico.

Philip S. Adey (1995) looks at the relationship between the level of use of an innovative science curriculum, Cognitive Acceleration through Science Education (CASE), and student achievement. Adey claimed that the findings in this study represent a confirmation of the effectiveness of the CASE inservice program and is a demonstration of how a staff development program may successfully be evaluated using

a process-product design. The study looks at the staff development for implementing an entire curriculum. It does not look at staff development for particular instructional strategies of staff members. Data for student achievement are gathered and analyzed on the basis of a pre- and post- test methodology. It does not adequately address the specific variables looked at by the researcher linking staff development to pupil performance.

Wen-Hua Chang (1996) studied the effects of staff development for science instruction based on a learning cycle teaching approach. Through this research teachers experienced the social constructing of knowledge and were promoted to a better understanding about the philosophy of science. This research does not connect professional development to the performance of children.

David L. Radford and Linda L. Ramsey (1996) investigated the effect on teachers and their students of a model professional development that immerses teachers in scientific inquiry that could be used in their classrooms while modeling for the teachers the use of reform-based pedagogical strategies for teaching science. The program was found to have statistically significant impact on the teachers, their classrooms, and their students. Data were collected from open-ended questionnaires, journals, and learning logs of both teachers in and out of the program, and matched groups of students. There is no direct link in this study to the performance outcome of the students as a result of the staff development.

Ann S. Rosebery and Gillian M. Puttick (1997) looked at the relationship between professional development and the use of situated inquiry in science education. This study deals with teacher practice and does not extend the research to pupil performance.

Greenwood and Scribner-Maclean (1997) conducted research on the results of an 8-day summer science institute for elementary teachers. Pre- and post-tests were administered. At the end of the institute and 2 months later, more teachers appeared able to state science ideas addressed in the institute. Only small gains were made in the ability of these teachers to explain the same concepts in a way that might help children to understand. There was minimal evidence of conceptual change that would be necessary for elementary teachers to accommodate the new science ideas.

Next, the learning from this institute was examined to see if teacher learning would progress through phases (Shuell, 1990). This phase learning occurs through memorizing of facts and keeping them as isolated pieces of information or related to preexisting schemata. Over time, teachers would begin to identify relationships between the pieces of information they are accumulating and then networking these concepts. The networks are, however, rudimentary and do not completely allow autonomy of use for the teacher. Conceptual change occurs when a deeper understanding of material ensues and the teacher can flexibly apply the material throughout a variety of contexts. The result of this further investigation identified initial and intermediate phases of learning prior to the conceptual change needed to effectively teach these concepts to students. This study looked at the use of questions but as a prelude to an exploration by teachers during a summer research workshop. It did not address the area of how this questioning influences pupil performance.

Vincent A. Anfara, Jr., Susan T. Danin, Kathy Melvin, and Harry Dillner (2000) investigated the effects of a science professional development initiative developed by the Delaware State Department of Education. The program was the

Science Van Project. This study looked at the intervention of a specialist who visited in a science van with a set of laptops who worked alongside the elementary classroom teacher and conducted science investigations. Results of student data were collected from pre- and post-test results. This investigation does not examine the professional development of staff members alone and does not examine pupil performance in an experimental methodology to understand the exact impact of the staff development.

### Theory and Policy on Staff Development

Research has been conducted since the release of A Nation At Risk (National Commission on Excellence in Education, 1983) report. These studies have looked at the best methods to link adult learning, and the most effective professional development models (Bennett, Joyce, & Showers, 1987; Wood & Thompson, 1993). While these studies have served to define characteristics and critical elements for effective staff development, the effects of this research have varied widely with numerous exceptions to these rules (Guskey, 1999).

In the mid-1980s, the focus of staff development began to move away from the practitioner to look at student learning as the ultimate result of staff development. For most staff developers, the true purpose of staff development became providing educator's with the professional knowledge and craft skills they needed to help all students learn at high levels (Guskey, 1999). Guskey (2000) has outlined the advantages of evaluating professional development in terms of its impact on student learning outcomes: (a.) it offers new perspectives on old problems, (b.) it promotes high expectations and more rigorous standards, (c.) it

broadens perspectives on the factors that influence professional development, and  
 (d.) it empowers professional developers to make what they do count.

Dennis Sparks (1997) echoed this sentiment.

At a time when experts view staff development as an essential ingredient in school reform efforts that seek high levels of learning for all students, most staff development and school improvement activities continue to leave teachers' knowledge and skills untouched. Staff development must change if it is to prepare teachers and administrators to successfully implement content standards. It must be result-driven, standards-based, and demonstrate high expectations for the learning and performance of students and staff alike. (p. 20)

Sparks explains what these terms results-driven and standards-based mean:

1. Results-driven. Staff development must begin with a clear sense of what students need to learn and be able to do. That controls decisions about curriculum, instructional practices, and assessment. Ambitious intentions for students - and the changes required throughout the system - provide a powerful rationale for staff development.
2. Standards-based. Staff development that is most effective will be based not only on standards for student learning, but on standards for teaching and staff development as well. Standards for teachers - such as those developed by the National Board for Professional Teaching Standards - provide a benchmark for professional practice and a focus for what teachers need to learn

to be successful. Standards for staff development - such as those developed for elementary schools by the National Staff Development Council (1995) - allow school faculties to assess the quality of their current staff development efforts and make improvement where necessary. (Sparks, 1997, p. 21)

The mandate for results-driven staff development to meet the needs of standards-based education has not resulted in widespread use of these recommendations. The literature indicates a lack of significant evidence of this type of professional development in school systems in New Jersey, the United States and around the world.

The New Jersey Department of Education (2000) through the Office of Standards and Professional Development has set forth policies for the professional development of teachers and educational services personnel to insure that they have experiences that are meaningful, challenging and aligned to student learning. William A. Firestone, Gregory Camilli, Michele Yurecko, Lora Monfils, and David Mayrowestz (2000) examined the state of staff development in New Jersey. They looked at the teaching of math and science in the fourth grade with the introduction of state standards and assessments. They discovered that these policies have promoted the teaching of additional topics in both areas. However, the changes in the delivery of staff development have not yet been sufficient to lead to substantial changes in instructional practice.

Eric Hirsch, Julia E. Koppich, and Michael S. Knapp (1998) developed a paper for the U.S. Department of Education's first report on teacher quality,



informing the ongoing work on state policy contexts for the improvement of teaching undertaken by the Center for the Study of Teacher Policy. They investigated how states are motivating and supporting teachers' ongoing professional development. They examined the differences in the quality of opportunities for professional learning, state guidance and resources for professional development, and developing or mandating specific targets for professional development. They did not find assessment of staff development being linked to pupil performance in states across the United States.

Tabata Yoshinori and Lyckle Greik (1999) edited a seminar report for UNESCO-APEID (Asia-Pacific Program of Educational Innovation for Development) Program on Innovation and Reform in Teacher Education for the twenty-first Century in the Asia-Pacific Region. The report focused on ensuring opportunities for the professional development of teachers. Experts from 10 Asian countries presented papers on the current situation in their countries. The results were similar to reports from other countries. These like the United States deal with issues similar to America. There was a lack of information connecting staff development to pupil performance.

Edward P. St. John, James G. Ward, and Sabrina W. M. Laine<sup>1</sup> (1999) produced a framework of questions to guide policy makers as they link professional development to student outcome. They want states to develop policy, which connect staff development in a specific way. The question they ask in this regard is whether or not state professional development programs are linked to student outcomes in coherent ways? State agencies make substantial

development through embedded subsidies. The latest wave of reform has focused on specifically directed subsidies with relatively little attention being paid to accountability for these embedded subsidies.

#### Literature Review Conclusion

No research exists which specifically examines the relationship between teacher development and student outcome as assessed by performance indicators. The literature, in fact, supports the need for such research.

### Chapter III

#### RESEARCH DESIGN, PROCEDURE, and DATA ANALYSIS

The purpose of this chapter is to describe the participants, instruments and testing procedures, which will be employed in this study. The instruments and processes were used to research the process and outcomes of third grade teachers in the use of science questioning strategies. A post-treatment assessment of student achievement was performed as an indicator of effectiveness.

Effective training of elementary teaching staff in the area of science is a goal of the subject district. The New Jersey State Standards with regard to the Elementary School Proficiency Assessment (ESPA) performance have heightened this need and elevated this particular goal to a priority status. The need was pinpointed to grade levels prior to the fourth grade in an effort to expand the district's ability to increase the skills of students entering the fourth grade. For this study, the third grade teachers were targeted for staff development.

#### Research Design

A true experimental design was utilized in this study. A posttest only control design was employed. The group assignment was made on a random basis, which controlled for selection and mortality. This research design controlled for all threats to validity and sources of bias (Campbell and Stanley, 1963).

Specifically, a criterion-group design was used since the research was conducted in an ongoing educational environment. A posttest comparison between the experimental and control groups evaluated the differences in effective teacher use of higher-order questions. The differences in frequencies of student responses on open-ended, rubric-

scored science questions was examined from the experimental group of students whose teachers had received the treatment as compared to the control group whose teachers had not receive the treatment.

### Procedure

#### Subjects

The subjects of this study were 120 third grade students who made up a "blind" experimental set. Responses by students were randomly selected from a matched control and experimental group of 60 members each. These groups were matched on the basis of IQ, academic performance, and socio-economic background for both the experimental and control participants. Students and their parents or guardians signed release forms indicating their knowledge of the process and willingness to participate in the study on a voluntary basis.

#### Intervention - Workshop

A workshop was designed on the use of effective, higher-order questioning strategies in science for third grade teachers across the district. These workshops were conducted in the district by the elementary science staff developer. The credibility and expertise of this person had already been established with the third grade teachers. This was a familiar role in the district for the researcher and was an extension of the trust relationship already in place as the research process occurs. The researcher occupied a line position with teachers in this district and already had the ability to enter teachers' classrooms to observe and aid in the teaching process. This activity was part of the researcher's job description. The researcher was in no way responsible for supervising or

evaluating teachers and there was no existing feeling of coercion in the researcher's presence in the learning environment.

As a routine of the staff development process within the district, 14 third grade teachers were given the treatment at one time and 13 third grade teachers were given the treatment at a later time. The practice, which existed in the researcher's school system, was to release only half of a particular group of staff members at one time, due to the availability of substitute teachers to cover classes. Eventually 27 third grade members received the training.

Teachers were fully informed of all aspects of the study. The third grade teachers were asked to complete surveys of their backgrounds, academic and teaching experiences to determine criteria for pre- and post grouping procedures. Teachers were matched on the basis of this information. Observations of all of the teachers were conducted prior to the beginning of the research process. After the workshop was conducted with the first half of the teachers, an open-ended question on the subject matter was administered to all of the third graders. The second half of the third grade teachers were then given the workshop.

Teachers who received the first workshop all had similar backgrounds. They had not been observed using higher-order questioning strategies in their classrooms prior to the workshop. This was determined on the basis of pre-workshop observation by the researcher. They had similar academic histories of science coursework, presumably limited in nature. They also had similar years of teaching experience in the third grade and similar style of teaching science in their third grade classrooms.

### Pre-Workshop Observation

All third grade staff members participating in the study were observed by the researcher prior to the workshop process. An assessment was made of the teaching styles of the staff. If any member employed the strategies that were presented in the workshop, they were excluded from the study.

### Description of Workshop

A workshop was presented to the experimental group of the third grade teachers. The staff was given instruction in higher-order thinking skills based on Bloom's Taxonomy (Bloom, 1956). Particular types of questions and levels of information that they access were demonstrated to the teachers.

To illustrate the use of these strategies in a classroom setting, an experiment was conducted with a group of third grade students and recorded on video. These students were taken from the third grade class during the school year just prior to this research. The researcher modeled the desired behavior with students to the staff utilizing a variety of questioning strategies during the experiment and as a follow-up with the third graders to identify information learned by each child.

The teacher observers were given worksheets with tally areas for specific types of questions listed reflecting levels of higher-order thinking skills (Bloom, 1956). The teacher observers recorded the types and frequencies of questions posed to the students throughout the videotaped lesson.

After viewing the video of the laboratory session with the students, there was a debriefing session. Here the teachers were able to discuss their observations and the implications of these observations with the researcher.

Teachers were given a quantity of these tally sheets used during the workshop process. They were instructed to practice these acquired skills in the time following the workshop.

A schedule for classroom visitations by the researcher was established. Here the teacher conducted a post-workshop lesson on an identified science topic.

The researcher visited their classes while they conducted the lesson themselves. The researcher logged data about the questioning strategies employed by the teacher during this actual lesson. Participants were reminded that this was not evaluation of them, but rather a research-based opportunity to assess the effectiveness of the in-service process.

#### Student Assessment

When the experimental group of teachers completed the process of teaching the science lesson in their classroom and the researcher observed and documented the process, third grade students, both from the experimental and control teachers, were assessed. This assessment was an open-ended, rubric assessment involving the use of higher-order thinking responses on the part of the third graders. All third grade students in the district were taught this topic in science at this point, including the control groups, as a function of the curriculum time line for third grade science in the district.

The researcher collected all the rubric assessment papers from the 27 third grade classes. The researcher scored these papers. The researcher tallied the data from the observation sheets on the frequency and type of higher-order questions asked by teachers from the experimental groups during the post-observation sessions by the researcher.

### Follow-up Workshop

A second workshop was conducted with the control group of third grade teachers. The workshop was the same higher-order questioning process as the one conducted with the experimental group but with a new science topic. The same video experiment of the researcher with the group of students was viewed and again served as the model for the control staff observers. Tally sheets were given to the control group of staff members to record types and frequencies of questions used. The researcher made follow-up visits to the control classrooms. Observations and recording of data on the use of higher-order questioning by teachers in the control groups during science classes was performed. This follow-up workshop was not part of the research but was performed to provide the same staff development to all third grade teachers in the district, not just the experimental group.

### Data Analysis

A nonparametric study was performed using chi-square to evaluate the frequencies of rubric responses. Both quantitative and qualitative data and data analysis were employed.

The qualitative components of the study were: (a.) the incorporation of a pre-workshop survey of teacher background and teaching style, (b.) pre-workshop observations of teacher instructional styles conducted by the researcher, and (c.) question-asking tallies observed by the researcher during post-workshop observations of the teachers in their classrooms.

The quantitative component of the study involved an analysis of the open-ended responses of the students following a science lesson taught to both experimental and



control classes. These responses were scored by the use of a rubric. The rubric scores were then analyzed by a chi-square analysis.

## Chapter IV

### RESULTS

The purpose of this chapter is to present the results of this study. The results will be presented as qualitative results and as quantitative results. The data are completely presented and explained in each area. Tables and figures will be included where appropriate to accompany explanations of the results.

#### Qualitative Results

Observations of all 27 third grade teachers in their classrooms while teaching were made. Field notes on the questioning style of each teacher were recorded. Observations were done on the basis of: (a.) the kinds of questions asked by the teacher, (b.) the kinds of responses given by pupils, (c.) the pattern of teacher questions (i.e., only hands up, etc.), (d.) the follow-up and reinforcement given by the teacher, (e.) the position of the teacher in the classroom, (f.) the arrangement of desks in the classroom, (g.) the numbers of students per class, and (h.) percentage of teacher participation versus pupil participation.

The results of these observations are detailed in Table 1. In all observations it was noted that the teachers employed only questions on the lower end of Bloom's taxonomy (1956) in the areas of knowledge, comprehension, and application. No teachers utilized the upper levels of Bloom's taxonomy (1956) in the areas of analysis, synthesis, and evaluation in their normal course of instruction in their classrooms. On the basis of these observations it was determined that all 27 third grade teachers could be included in the experiment. No one possessed the questioning strategies prior to the staff development workshop, which would indicate that they already possessed the

Table 1

Results of Pre-Workshop Teacher Observation

Teacher Question Low or High Bloom's	Pupil Response	Patterns Of Teacher Question	Teacher Follow- Up	Teacher Position In Class- room	Desk Arrange- ment in Room	Number Of Students	Teacher Vs Pupil Participation
Low	Rote	Student Hands up	None	In front of class	Paired rows	25	Teacher Dominant
Low	Rote	Student Hands up	None	In front of class	Paired Rows	25	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Paired rows	25	Teacher Dominant
Low middle	Rote and Some open- ended	Encouraged All pupils	Some	Through Class	Teams	18	Fifty/Fifty
Low	Rote	Student hands up	None	Sitting in front of class	Paired rows	18	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Horse- Shoe	20	Teacher dominant
Low	Rote	Student hands up	None	Through class	Paired desks	20	Teacher dominant
Low	Rote	Student hands up	None	Sits at desk	Single Pairs Triplets	18	Teacher dominant
Low	Rote	Team answers	Some	Through class	Teams	20	Peer coaching
Low	Brain- storming	Student hands up	Some	Through class	Single pairs Triplets	19	Fifty/fifty
Low	Rote	Encouraged all pupils	None	Through class	Paired rows	20	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Paired rows	21	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Paired rows	20	Teacher dominant
Low	Rote	Picked names	None	In front of class	Groups	23	Teacher dominant

(Table cont.)

Table 1

Results of Pre-Workshop Teacher Observation

Teacher Question Low or High Bloom's	Pupil Response	Patterns Of Teacher Question	Teacher Follow- Up	Teacher Position In Class- room	Desk Arrange- ment in Room	Number Of Students	Teacher Vs Pupil Participation
Low	Brain- Storming	Student hands up	None	Through class	Horse- Shoe	20	Fifty/fifty
Low	Brain- Storming	Student hands up	None	In front of class	Groups	23	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Groups	23	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Rows	23	Teacher dominant
Low	Rote	Picked names	None	In front of class	Paired rows	22	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Horse- Shoes	21	Teacher dominant
Low	Rote	Student hands up	None	Through class	Paired rows	23	Teacher dominant
Low	Rote	Student hands up	None	In front of class	Rows	21	Teacher dominant
Low	Rote	Student hands up	None	Through class	Groups	19	Teacher dominant
Low	Rote	Called on each other	None	In front of class	Paired rows	18	Teacher dominant
Low	Rote	Picked names	None	In front of class	Paired rows	20	Teacher dominant
Low	Rote	Student hands up	None	Through class	Paired rows	19	Teacher dominant
Low	Rote brain- Storming	Student hands up	None	In front of class	Paired rows	19	Teacher dominant

intervention to be used, and would cause them to be dropped from the study.

Teachers completed the teacher questionnaire providing demographic information on their educational and teaching background. None of the teachers had any additional science coursework beyond teacher training courses in science provided in their undergraduate college course of study. The results of these questionnaires are detailed in Table 2. The teacher questionnaire, which was completed by each teacher, may be found in Appendix A.

The results of these responses indicate that there is a varied background in both years of teaching and years of teaching third grade. Teachers perceive themselves as utilizing a variety of methodologies instructionally in their classes and in their science teaching. During the pre-workshop observation, the vast majority of instruction was teacher dominated. The questions used by teachers were predominantly the lower levels of Bloom's taxonomy (1956), that guided students toward convergent, single concept responses. Although there were some grouping arrangements of desks with brainstorming used by students, no varied instructional strategies such as multiple intelligences or multi-sensory instruction were observed.

While many of the staff members indicated completion of additional post-graduate coursework, only seven teachers have an earned post-graduate degree. Most of the third grade teachers possess only one teaching certificate. Only five staff members indicated having additional teaching certifications. None had any teaching certificates in science.

Table 2

Results of Teacher Questionnaire on Educational and Teaching Background

Teacher perception of teaching style	Teacher perception of science teaching style	Experimental or control group	No. of years teaching	No. of years teaching third grade	No. of teaching Certificates	No. of post graduate credits	No. of post graduate degrees	No. of science courses
Notes oral multi-sensory	Brainstorming oral written	Experimental	26.6	14	1	9	0	0
Multiple intelligence Multi-sensory	Talk Experiment Write	Control	19	7	2	30	0	0
Multi-sensory creative	Discussion hands-on	Experimental	26.6	11	1	48	1	1
Holistic Socratic	Include in other subjects	Experimental	25	17	1	84	1	2
Structured and flexible	With reservation	Experimental	9	1	1	18	0	2
Variety of inst.strateg. for diverse learners	Hands-on diagram literature	Experimental	24	20	1	37	0	3
Multi-sensory	No respons	Control	26	23	1	48	0	1
Multi-sensory	Hands-on demos charts books movies	Experimental	17	7	1	48	0	3
Traditional	Traditional hands-on	Control	31	30	1	48	0	2
Traditional manipulatives Models graphs charts	No response	Control	20	5	1	0	0	0
Hands-on exploration open-ended	Hands-on lecture/note experiment	Control	5	3	1	0	0	0

(Table continues)

Table 2

Results of Teacher Questionnaire on Educational and Teaching Background

Teacher perception of teaching style	Teacher perception of science teaching style	Experimental or control group	No. of years teaching	No. of years teaching third grade	No. of teaching Certificates	No. of post-graduate credits	No. of post-graduate degrees	No. of science courses
Caring flexible	Experiment discussion	Control	24	7	1	0	0	0
Student-centered organized basic skills	Hands-on	Experimental	23	19	1	82	1	2
Enthusiastic	Hands-on experiment	Experimental	2.25	2.25	1	0	0	2
Teacher lead discussion Videos hands-on	Videos dittos hands-on	Control	7	.25	1	48	0	4
No particular style	Lessons video notes hands-on	Control	5.5	3	2	48	1	2
No response	No response	Experimental	23	15	3	48	1	1
Traditional hands-on higher level thinking	Not enough time to teach science	Control	5	5	1	0	0	0
No response	Inquiry method	Control	.25	.25	1	0	0	0
No response	Hands-on	Experimental	19	19	1	32	0	0
Relaxed with discussions	Laser disc worksheets open-ended	Control	25	9	1	0	0	2
No response	Laser disc	Experimental	14	7	4	48	1	0
Traditional	Not sure new to grade 3	Control	6	.25	3	48	1	0

When the experimental group of teachers completed their staff development training in the use of higher-order questions in their science instruction, they repeated the lesson they had seen modeled during the training session in their own classrooms. A Question Asking Tally Sheet was completed for each experimental staff member as they taught their lesson recording the type and frequency of questions asked during the instruction. The results of the frequencies of questions asked by teachers are detailed in Table 3. The actual Question Asking Tally Sheet may be found in Appendix B.

A predominant number of staff members in the experimental group asked questions, which were scattered fairly uniformly across all of the levels of Bloom's taxonomy (1956) in their follow-up science lesson in their classroom. They demonstrated a use of more questions in the upper levels of Bloom's taxonomy (1956), which was a difference from the types of questions noted as being asked during the pre-workshop observation. These questions generated divergent thinking responses from the students. Two members of the experimental group appeared to have a great deal of difficulty going much above the lower, convergent levels of Bloom's taxonomy (1956). The staff developer intervened in the lesson to aid the students in the comprehension of the science material. Subsequently, these two teachers in the experimental group were dropped from the study. The results of these Tally Sheet frequencies are reported in Table 3. This resulted in a total of 12 experimental groups continuing on in the study. Student results for the experimental group were taken from these 12 and none were taken from the two classes, which were eliminated from the study.



Table 3

Question Asking Tally Sheet Frequencies for the Experimental Group of Teachers

Teachers No.	Convergent Thinking			Divergent Thinking		
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
1.	2	4	2	5	3	7
2.	5	6	3	4	3	5
3.	3	3	2	5	6	6
4.	4	4	3	4	4	5
5.	5	4	5	6	4	5
6.	3	3	2	4	4	6
7.	4	3	4	3	0	0
8.	7	3	1	3	0	0
9.	6	4	3	4	3	4
10.	1	1	3	4	5	5
11.	5	2	1	5	3	4
12.	2	1	2	4	4	4
13.	2	3	3	2	4	3
14.	3	2	2	5	5	7

### Quantitative Results

Quantitative data are included in this study to present the data in a way that makes the information clear as to the level of significance of the results. By examining the data for frequency of results and calculating chi-square analysis of this information, the appearance of specific results takes on a meaning that helps to interpret and explain what was learned from this study.

Upon the completion of each experimental group lesson presented by the teacher to his or her class, the students were given an open-ended, rubric-assessed question on the laboratory experience to complete. These were given directly at the end of the experiment and completed before the follow-up classroom lesson was finished.

The control teachers, who had not yet received the staff development workshop on the use of higher order questions, also taught the lesson to their classes. The same open-ended question was given to their students after the material had been covered and the classroom teacher conducted the laboratory experience. The rubric scores ranged from a 0 indicating no proficiency on the topic, to 1 indicating only partial proficiency, to 2 suggesting proficiency, to 3 indicating advanced proficiency. These categories are the same as the Elementary School Proficiency Assessment administered to all fourth graders in the state during the months of April and May each year.

Five student results from each of the control classes and five results from each of the experimental classes were chosen. These students were picked by use of a random table of numbers and matched for I.Q., academic and socio-economic background. Each factor was chosen in the following way:

I.Q. was chosen by student results on the Cognitive Abilities Test (1993). Students were included if they fell within the I. Q. range of standard age scores (SAS) between 85 and 115. This range was determined from the average normal range of standard age scores in the standard normal curve of the population distribution. The population mean for the standard age score of IQs is 100 with a standard deviation of 15. This represents the average normal population range of SAS, which falls between I.Q. SAS of 85 and 115.

Academic background was matched by eliminating students who received basic skills instruction or who were in the gifted and talented program. The range of I.Q. chosen eliminated those students who were in the gifted and talented program since a base standard age score for I.Q. of 120 is required for admission into the program. Basic skills instruction students were determined by use of the TerraNova Basic Multiple Assessment Plus (1997). Those students who received a National Percentile Rank of below 25% for mathematics, reading, or language were excluded from the study since that is the established district guideline for providing basic skills instruction to a particular student.

Socio-economic background was determined by the use of the Free- or Reduced-Price Lunch eligibility program. Students who receive either free- or reduced-price lunch require parents or legal guardians to provide proof of eligibility for this program which is determined by economic need.

Five students were randomly selected and matched from each of 12 experimental classes. This resulted in an experimental sample size (N) of 60. One of the control classes was eliminated from the study when the regular classroom teacher became ill and

a substitute took over within the course of the study. This allowed for 12 control classes with five students being randomly selected and matched for a control  $N$  of 60. The frequency of rubric scores for the control group is presented in Figure 1. The frequency of rubric scores for the experimental group is presented in Figure 2. The frequencies for each rubric score and the frequencies of low (0 and 1) results and high (2 and 3) results are presented in Table 4.

The overall rubric scores of the control group were compared with the overall rubric scores of the experimental group by means of chi-square analysis. The data for the chi-square analysis of the overall rubric scores for the control and experimental groups are presented in Table 5.

The control group had a much higher frequency of non-proficient zero responses, 24, than the experimental group, which had only four non-proficient zero responses. The control group had 30 partially proficient one responses compared to the experimental group which had only 19 rubric scores of one. Compared to the experimental group where 22 students received a proficient rubric score of two, the control group had only six students score a proficient two on the rubric assessment.

Finally, only the experimental group had students, which achieved a level of advanced proficiency on the rubric assessment. The experimental group had 15 students who received a rubric score of three. No control group members scored in the advanced proficient area on the rubric assessment.

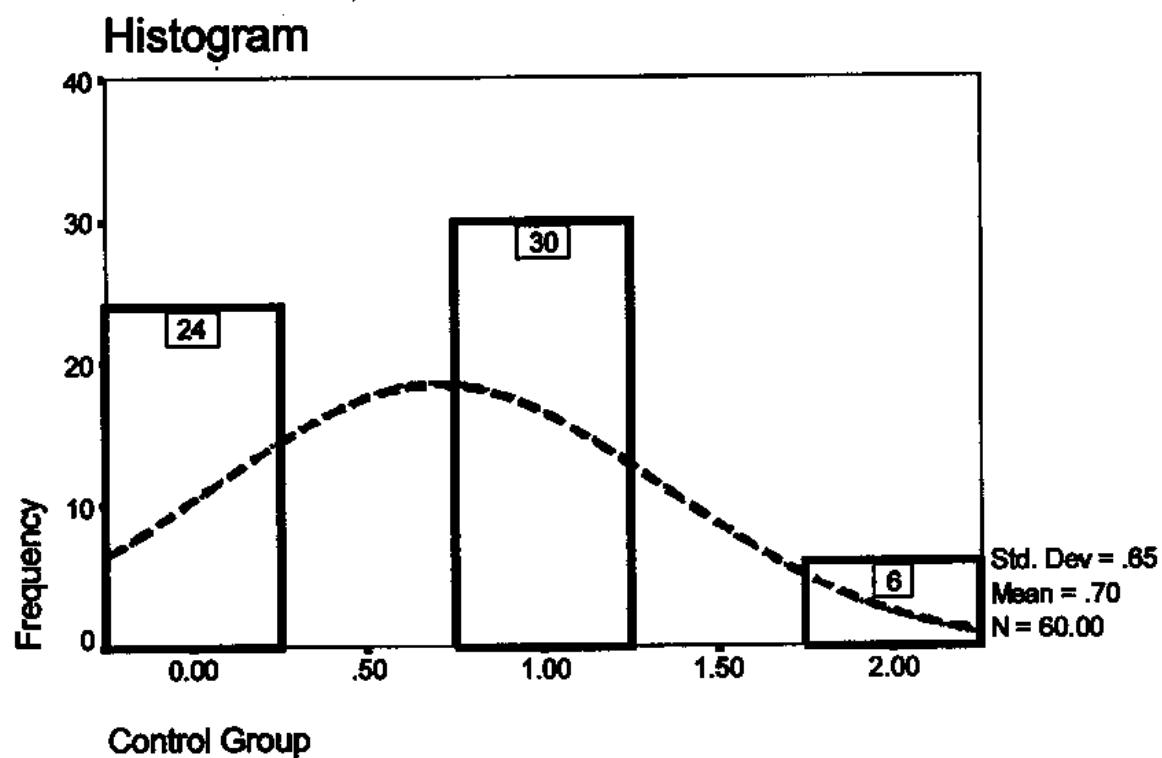
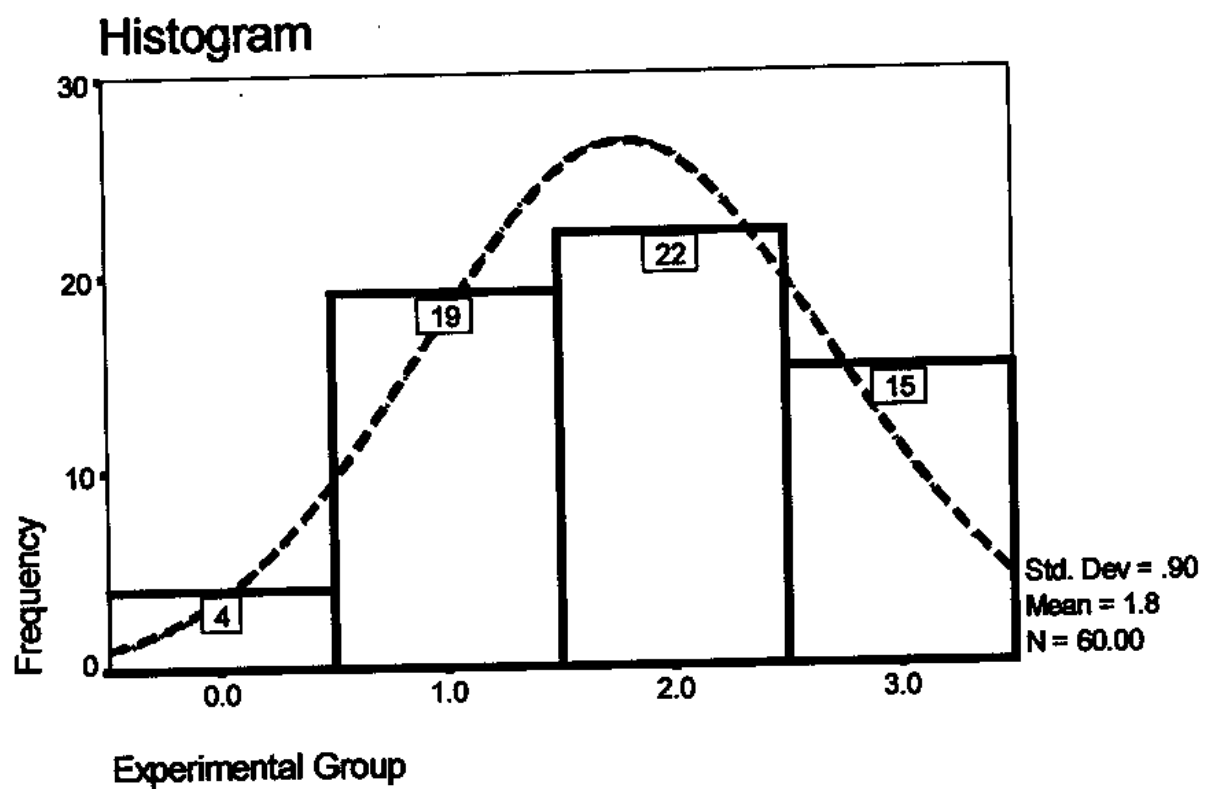


Figure 1. Frequencies of rubric scores for control student responses.



**Figure 2.** Frequencies of rubric scores for experimental student responses.

Table 4

Comparison of Frequencies of Rubric Scores for Control versus Experimental Groups

Control Rubric Results		Experimental Rubric Results	
Rubric Score	Percentage	Rubric Score	Percentage
0	40%	0	6.7%
1	50%	1	31.7%
2	10%	2	36.7%
3	0%	3	25%
0-1	90%	0-1	38.4%
2-3	10%	2-3	61.7%

A two-way chi-square test was performed to determine the significance of this difference in frequencies of each category in the experimental and control groups. A value for chi-square of 39.99 was calculated. This value exceeded the critical value of chi-square of 16.27 at three degrees of freedom (df) with a  $p$  value  $<.001$ . This indicated that the difference in frequencies observed between the experimental and control groups was not by chance. These results reject the null hypothesis. There is a statistically significant difference between the frequency of rubric responses from the control and experimental groups.

The data were further evaluated for the difference in frequencies between the experimental and control groups by students who scored in the low range on the rubric assessment of non- and partially proficient and students who scored in the high range on the rubric assessment of proficient and advanced proficient. The results were evaluated for frequencies in the low range of zero and one for experimental and control groups versus frequencies in the high range of two and three for the same groups. The data for the chi square analysis of the low range of rubric scores and the high range of rubric scores for the control and experimental groups is presented in Table 6.

There was also a difference between the control and experimental groups when low and high frequencies were examined. Only 23 experimental students received low rubric scores of zero and one indicating non- and partial proficiency on the rubric assessment. Fifty-four students in the control group received low results. In the high range of performance indicating proficiency and advanced proficiency, 37 experimental students received high rubric scores of either two or three while only six control students received high performance rubric scores.



Table 5

Chi-square Analysis of Individual Rubric Scores for the Experimental Versus the Control Group of Students.

	Frequencies of 0 Results	Frequencies of 1 Results	Frequencies of 2 Results	Frequencies of 3 Results	Total of Row Frequencies
Observed Experimental Frequencies	4	19	22	15	60
Expected Experimental Frequencies	14	25	14	8	
Observed Control Frequencies	24	30	6	0	60
Expected Control Frequencies	14	25	14	8	
Total of Column Frequencies	28	49	28	15	120

$$\chi^2=39.99 \quad df=3 \quad p<.001$$

A two-way chi-square test was performed to determine the significance of this difference in frequencies of low and high categories in the experimental and control groups. This time a value for chi-square of 45.8 was calculated. This value exceeded the critical value of chi-square of 10.83 at one degree of freedom (df) with a p value  $<.001$ . This indicated that the difference in frequencies observed between low performers and high performers in the experimental and control groups was not by chance. These results reject the null hypothesis. There is a statistically significant difference between the frequency of high and low rubric responses from the control and experimental groups.

#### Summary

The results of this study included a change in the use of higher order questions by staff members in science instruction. Randomly selected matched groups of third graders responses on a rubric assessment of an open-ended question administered by third grade teachers produced significantly different frequencies of rubric scores between experimental and control groups. The use of a chi-square analysis of the differences in frequencies between experimental and control responses produced a p value  $<.001$  indicating that the differences in results was not random or occurring by chance.

These results reject the null hypothesis in two ways: (a.) there is a statistically significant difference between the experimental and control groups in the frequencies of each rubric category, and (b.) there is a statistically significant difference between the experimental and control groups in the frequencies of high (2-3) and low (0-1) rubric responses.

Table 6

Chi-square Analysis of High and Low Rubric Scores for the Experimental Versus the Control Group of Students.

	Frequency of Low 0-1 Results	Frequencies of High 2-3 Results	Total of Row Frequencies
Observed Experimental Frequencies	23	37	60
Expected Experimental Frequencies	39	22	
Observed Control Frequencies	54	6	60
Expected Control Frequencies	39	22	
Total of Column Frequencies	77	43	120

$$\chi^2=45.8 \quad df=1 \quad p<.001$$

## Chapter V

### SUMMARY, CONCLUSIONS, and RECOMMENDATIONS

#### Summary

##### Introduction

The focus of this study was the staff development of third grade teachers in the use of higher-order questions in science teaching. The study investigated how this training affected the performance of students in science. A true experimental design was used. This design allowed the researcher to examine the effects of the staff training on students who had been instructed by teachers trained in the use of higher-order questions compared to the performance of third graders who were taught by staff members who had not received the training.

The performance of students was assessed by an open-ended question, which was scored by the use of a rubric. This type of question requires higher-order thinking on the part of the students (Bloom, 1956). In this way, the effects of strategic questioning practices of staff members during science instruction could be examined by looking at the responses of students to the open-ended question.

A chi-square analysis was used to determine if any differences in the results of the experimental and control student responses existed. The values of this statistic lay in the analysis of the frequencies of responses and making a comparison of these frequencies between the experimental and control responses. This analysis would be able to determine whether the differences in frequencies were statistically significant.

Naturally, regardless of the context, data on student achievement should inform policy and practice in education (Firestone et al., 2000). This research has implications

for the design, implementation, and assessment of professional development as well as for administrators and principals in their role as instructional leaders.

### Conclusions

The results of this research demonstrated a relationship between the staff training of third grade teachers in the use of higher-order questions and the performance of students in science on a rubric-scored open-ended question. There was a statistically significant difference in the achievement of the control and experimental groups of third grade responses.

### Hypothesis

The null hypothesis was used in this research. Little experimental evidence existed in the area of staff development with regards to pupil performance. Therefore, the hypothesis was forwarded that there would be no statistically significant difference between the response of the experimental group of third graders and the response of the control group of third graders as a result of the staff development intervention.

### Discussion of the Qualitative Data

Pre-workshop observations of all 27 third grade teachers revealed that the predominant instructional practice being used at the time of the research was a traditional, teacher dominated, rote style of teaching. Students were passive learners. Prior to the workshop third grade teachers were observed asking most of their questions from the lower levels of Bloom's taxonomy (1956) in the areas of knowledge, comprehension, and application. Only one staff member in 27 asked several questions from the analysis level. From the observations of the experimental staff members during the science lesson conducted following the staff development training, the teachers were asking increased

numbers of higher-order questions in the areas of analysis, synthesis, and evaluation (Bloom, 1956).

Pre-workshop observations of staff revealed that the questions from teachers in the lower levels of Bloom (1956) produced only rote, convergent answers that required only content, single concept information. After the staff development intervention, observations made during the science lessons of the experimental teachers revealed higher-order responses from students. Students responded with answers, which required process thinking in the analysis, synthesis, and evaluation levels of Bloom's taxonomy (1956).

Anecdotally the researcher could observe during the pre-workshop observations, a distinct difference in the level of responses from students between the experimental and control groups of third graders. The mean rubric score for the control group was .7 and the mean rubric score for the experimental group was 1.8, which represented a difference of 1.1. This indicated that the training of the experimental group of teachers in the use of higher-order questions produced a result of an entire rubric score gain in achievement for the experimental group of third graders. The control mean of .7 places the mean score at about one, which is in the lower end of the performance scale and indicates that the mean performance of students in the control group was only partially proficient. The mean rubric score of 1.8 for the experimental group of third graders places them at about 2, which is proficient. This indicates that the experimental group of third graders demonstrated a higher level of thinking response than the control group.

### Discussion of the Quantitative Data

The null hypothesis in this study stated that there would be no difference in the performance of third graders on an open-ended, rubric assessed question between those who had been instructed by teachers trained in the use of higher-order questions and teachers who had not been trained in the use of these questions.

There was a difference in the frequencies of rubric responses between these two groups. The control group of students had 40% 0 responses, 50% 1 responses, 10% 2 responses, and 0% 3 responses. The rubric responses were also compared on the basis of low 0-1 (non-proficient) responses and high 2-3 (proficient) responses. The control group had 90% low responses and only 10 % high responses.

There was a dramatic difference in the frequencies of responses for the experimental student responses. The experimental group of third graders had only 6.7% 0 responses, 31.7% 1 responses, 36.7% 2 responses, and 25% 3 responses. The rubric responses for the experimental group in the low range were only 38.4%, while the high group was 61.7%.

The frequencies of rubric scores for each category shows a higher frequency of responses at the lower end of the rubric for the control group as opposed to a higher frequency of responses at the higher end of the rubric for the experimental group. These comparative differences reflect the level of questions used during instruction by the control teachers versus the experimental teachers. These comparisons further reflect the level of thinking required and demonstrated by the control group of third graders versus the experimental group of third graders. The control group of students responded to the open-ended question with a much higher frequency of lower-order thinking (Bloom,

1956). This reflects a more rote response to the question. The experimental group of students responded to the open-ended question with a much higher frequency of higher-order thinking (Bloom, 1956).

These differences in frequencies of responses between the control and the experimental groups also reflect a difference in the level of mastery of the material being presented. The 0 and 1 rubric response correspond to non-proficiency and partial proficiency respectively. An overwhelming 90% of control responses were within this range. The predominant adherence to rote answers to the open-ended question demonstrated the inability of these students to access the higher-levels of thinking required to effectively respond to the open-ended question.

Conversely, a dramatic 61.7 % of the experimental students responded in the proficient and advanced proficient levels. These rubric scores correspond with the upper levels in Bloom's taxonomy (1956). The students who received instruction by teachers trained in the use of higher order questions were able to extend their thinking to well beyond rote, convergent responses to the divergent thinking required for open-ended questions (Cardellichio & Field, 1997; Gagne, 1965).

The significance of these results was addressed through the use of the chi-square statistic. The analysis of the frequencies of each rubric category comparing the control responses versus the experimental responses produced a value of 39.99. The critical value for this response was 16.27. This indicated that the calculated chi-square value far exceeded the critical value. The p value attached to this chi-square was  $<.001$ . The probability that the differences in frequencies between the control and the experimental group were a random occurrence was less than .001. This demonstrates that the results



produced were not a result of chance. The null hypothesis is rejected. There is a difference in the performance of third grade students on an open-ended question between those instructed by teachers trained in the use of higher-order questions and those not instructed in this strategy.

The analysis of the frequencies of low and high frequencies of rubric responses comparing the control responses versus the experimental responses produced a value of 45.8. The critical value for this response was 10.83. This indicated that this calculated chi-square value far exceeded the critical value. The p value attached to this chi-square was  $<.001$ . The probability that the differences in frequencies between the control and the experimental group were a random occurrence was less than .001. This demonstrates that the results produced were not a result of chance. The null hypothesis is rejected. There is a difference in the performance of third grade students on an open-ended question between those instructed by teachers trained in the use of higher-order questions and those not instructed in this strategy. This second chi-square analysis further indicates that there is a distinct difference in the level of higher-order thinking that is exhibited between the experimental and the control students. This higher level of thinking exhibited by the experimental group of third graders is not a chance occurrence and can be linked to the staff development training of the experimental group of third grade teachers.

### Interpretation of the Results

From the pre-workshop observations and the teacher questionnaires it was clear that the third grade teachers in this study did not possess the questioning skills as demonstrated in Bloom's taxonomy (1956). The staff was not a new staff and had been

teaching for a number of years and also had multiple years of experience in the third grade. Many had pursued advanced coursework. None of the teachers had significant educational background in science. While the teachers perceived themselves as utilizing a variety of teaching techniques in both their regular and science instruction, upon observation they demonstrated a traditional teacher centered format using questions from the low end of Bloom's taxonomy (1956).

The results of the experimental teachers demonstrated a significant difference in the kinds and frequencies of questions used in the follow-up science lesson. The use of these questions elicited a higher mean rubric score on the results of the experimental classes as compared to the mean rubric score of the control classes. These results are not random and are attributable to the use of the strategies acquired during the staff development workshop.

It was hypothesized for this study that there would be no difference in the performance of students who were instructed by teachers who had been trained in the use of higher-order questions than students who were not instructed in the use of higher-order questions on a rubric assessed open-ended question. The results of this study indicate that the hypothesis can be rejected. The teachers who used a higher level of questions in their science instruction helped students to achieve greater proficiency with the material than those teachers who did not use the strategies.

### Recommendations

#### Implications of the Study

There are a number of implications from this study. Staff development directly influences instructional practices and pupil performance. The instructional practices of

teachers do, in turn, have a significant and measurable impact on the performance of students.

According to Piaget (1972), third graders are concrete thinkers. They do not possess the ability to think abstractly. The ability of the third graders to perform proficiently or advanced proficiently on the rubric assessed open-ended question requires the use of abstract thinking skills in the upper three levels of Bloom's taxonomy (1956). The fact that the students in the experimental classes performed at these levels in a significantly different manner from the control students, is directly related to the instruction of the experimental teachers, since the third graders would not have been able to build the abstract connections on their own to answer the open-ended question at the levels that they did. It is therefore important that quality staff development such as the kind demonstrated in this study be provided for teachers. Without this intervention, teachers will not be able to keep pace with the increasing demands for measurable student outcomes and as a direct result of this, students will fall behind (Guskey, 1999, 2000; Sparks, 1997).

This study has a bearing on the required New Jersey State assessments. The Elementary School Proficiency Assessment (ESPA), the Grade Eight Proficiency Assessment (GEPA), and the High School Proficiency Assessment (HSPA), all have open-ended questions throughout each of the sub-tests included in all three assessments. As demonstrated by this study, rote instructional strategies will not provide students with the skills necessary to answer the in-depth nature of these higher order questions (Firestone et al., 2000). Teachers must instruct with the same level of higher order methodology to provide students with ongoing practice for this type of assessment.

There is a link between teacher instruction with the use of higher order questions and methodology and the ability of students to perform in the proficient and advanced proficient categories on the state assessments. Students who are not instructed in this style, but rather with a rote, teacher centered, traditional methodology perform predominantly in the non- and partially proficient categories on an open-ended assessment (Darling-Hammond, 2000).

A further implication of this study is the need for direct classroom intervention by a knowledgeable individual to help guide staff with staff development interventions and to insure these new practices are successfully and routinely being utilized in their classroom practice. The role of the building principal in this regard becomes extremely important (Darling-Hammond, 1997).

Teachers may or may not implement strategies they have learned at staff development sessions. The only way to verify that the desired instructional practices are actively in use in the classroom is through regular classroom visitation. In the case of elementary teachers, this becomes the role of the instructional leader in the building, the principal. When staff members have difficulty with the new practice or are reluctant to use it, the principal can facilitate implementation by the teacher and can bring additional interventions into place as necessary. Without some documentation of the process, teachers will tend not to change their practice readily. This is verifiable by the control teachers who have received significant staff development in their district but have observable difficulty implementing it in their classrooms. This becomes a mandate for principals in light of the outcome of this study where the direct beneficiaries of the

implementation or lack of implementation of improved instructional practice in the classroom are the students (Darling-Hammond et al, 1983).

#### Limitations of the Study and Recommendations for Future Research

There are several limitations of this study, which are also recommendations for future research. This study needs to be replicated to determine if the results will be similar in other studies. Along this line, the following areas could be addressed in future research:

More school districts could be included in the study. This study was performed in the researcher's school system. This study needs to be replicated in other districts and in more than one district at a time. Districts with differing characteristics and factors could also be investigated.

Larger numbers of students could be included in the study. This study involved an  $N=120$  students. Larger numbers of students, perhaps whole demographic areas (counties, states, etc.) could be studied.

Students could be followed over a longer period of time longitudinally. The students in this study were followed for a period of 4 months. This study needs to be duplicated over a period of years.

Specific demographic groups could be studied individually instead of together. Gender, age, race, for example, could be studied individually to determine if these or other factors would influence the outcomes discussed in this research.

Different grade levels could be taken together and separately to see if these results can be duplicated. This research was limited to third grade. Middle or high school age students or early primary students as examples of alternate cohorts could be investigated.

The researcher conducted the workshop and the assessment. Therefore, the possibility for bias existed. An impartial observer could conduct the research.

There is a non-standardized instructional procedure used in the form of a rubric analysis. Standardized assessment instruments could be used in future research.

The time of day for the teacher training with some teachers receiving training in the morning and some in the afternoon might affect the learning ability of some teachers. All training could be conducted simultaneously in future research.

Although it was not address in the research, several observations emerged throughout the course of this study, which would also be areas for future research. It appeared that there was no connection between I.Q., academic or socio-economic background and performance of pupils when the use of higher order questions was incorporated into the instructional practice of teachers. Each of these separately or collectively could be looked at in connection with staff development and instructional methods of teachers.

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## Appendices

**Appendix A**  
**Teacher Questionnaire**

**Teacher Questionnaire**

Teacher Code \_\_\_\_\_

School Code \_\_\_\_\_

Number of Years of Teaching Experience \_\_\_\_\_

Number of Years Teaching Third Grade \_\_\_\_\_

Undergraduate degree \_\_\_\_\_

Concentration(s) of Coursework in College \_\_\_\_\_

Teaching Certification(s) \_\_\_\_\_

Post-Graduate Coursework \_\_\_\_\_

Post-Graduate Degree(s) \_\_\_\_\_

Science Background/Coursework \_\_\_\_\_

How would you describe your teaching style? \_\_\_\_\_

How would you describe how you teach science? \_\_\_\_\_

**Appendix B**  
**Question Asking Tally Sheet**

## Question Asking Tally Sheet

Teacher Code \_\_\_\_\_

School Code \_\_\_\_\_

	Convergent Thinking			Divergent Thinking		
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluate
Number Of Times Asked	Tell, list, choose, arrange, name, locate, repeat, quote, point to, check, recite, underline, identify	Translate, reword, expand, transform, retell, restate, infer, define, explain, outline, annotate, project, propose, calculate	Use, solve, apply, employ, utilize, make use of, mobilize, manipulate, practice	Examine, dissect, divide, take apart, investigate, discuss, uncover, simplify, deduce, conclude, extract	Create, combine, build, compile, make, structure, reorder, blend, reorganize, cause, develop, produce, compose, yield, construct, effect, generate, evolve, form, constitute, originate	Judge, decide, rate, prioritize, appraise, assay, rank, weigh, accept, reject, determine, assess, referee, umpire, arbitrate, rule one, award, criticize, censure, settle, classify, grade
1						
2						
3						
4						
5						
6						
7						
8						
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14						
15						
16						
17						
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19						
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21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
Total						

### **Appendix C**

#### **Cover Sheet for Third Grade Open-Ended Question**

#### **Open-Ended Question and Rubric**

## Cover Sheet for Third Grade Open-Ended Question

Student Coded I.D.  
Number \_\_\_\_\_

School Coded I.D.  
Number \_\_\_\_\_

Rubric Scores: Circle One

3

2

1

0

Scorer's Code: \_\_\_\_\_

Date Scored: \_\_\_\_\_

### Third Grade Open-Ended Question

How do the roots of a plant act like a drinking straw? How do the roots of a plant act differently than a drinking straw? Use what you have learned about plants to explain your answer.

#### Rubric for Open-Ended Question

- 3- point response:** Student response is reasonably complete, clear, and satisfactory. Student must include three or more of the following items in their answer:
1. Alike: Both a straw and roots carry liquids inside them.
  2. Alike: Both a straw and roots bring liquids up from a lower place to a higher place.
  3. Different: Roots need to have a much narrower diameter than a straw to work.
  4. Different: A straw needs suction to work and roots use capillary action to draw water up inside the root without any suction.
- 2-point response:** Student response has minor omissions and/or some incorrect or irrelevant information.  
Student includes two of the four items listed above.
- 1-point response:** Student response includes some correct information, but most information included in the response is either incorrect or not relevant.  
Student includes one of the four items listed above.
- 0-point response:** Student attempts the task but the response is incorrect, irrelevant, or inappropriate.



**Appendix D**  
**Principal, Teacher, Parent, Student**  
**Letters and Consent Forms**

Seton Hall University  
College of Education and Human Services

Dear Third Grade Staff,

As you may know, I am pursuing a Doctorate in Educational Administration and Supervision from Seton Hall University. This fall I will be conducting a research project with the third grade staff in Union for my dissertation. The project involves staff development on question-asking strategies used by teachers. All staff members will participate in the staff development. Participation in the research portion is entirely optional and voluntary. I will be collecting data on the results of this staff development on the performance of students by the use of a rubric assessment.

Half of the teachers will attend the staff development at one time. The second half of the third grade staff will attend the same staff development at a later time. Between the first and second staff development sessions all third grade students will be given one open-ended, rubric assessment, which I will score. This assessment does not need to be included in the students' grades and will be in addition to your regular testing on the particular subject covered in the science curriculum time-line at that point in the fall.

I will be requesting that teachers fill out a questionnaire providing demographic information to aid in the matching of groups to be tested. All questionnaires will be coded to maintain the confidentiality of the participants. I will be the only person to have access to the information and no names or identifying information will be used in the dissertation. Only aggregate results will be presented. I will also visit each teacher's classroom prior to the first staff development, to observe their teaching style. If any teacher already possesses the strategies, which will be presented in the staff development, then they would be automatically eliminated from the study. Upon the completion of the first staff development, I will visit the teachers who have participated to observe them teaching a science lesson and record the questioning strategies used during their lesson. When this process is complete for the first group, the rubric assessment will be administered to all the third graders.

Please remember that participation in the study is voluntary and that you may withdraw from the study at any time up to the end of the study without any fear of prejudice or reprisal. Any and all information is confidential and no individual results will be included in the study, only aggregate group data. You may request to view the data and the results and I will provide you with a copy of the information. If you wish to participate, please sign the enclosed consent form and I will send you a copy for your records. Please send the form back to me at Hamilton School.

Thank you for your cooperation in this endeavor.

Maryrose Sloan

Teacher Consent Form  
Seton Hall University  
College of Education and Human Services

Investigator: Maryrose Caulfield-Sloan  
A Candidate for the Executive Ed.D.  
Educational Administration and Supervision  
(908)-851-4698

**PURPOSE AND BENEFITS**

This is a research project for a doctoral dissertation in the Executive Ed. D. program at Seton Hall University. This research activity will study the role of higher order questioning strategies used by the classroom teacher as it relates to the assessable performance of students in elementary science. The expected benefits of this study would be a contribution to existing knowledge about elementary science teaching practices and potential implications for future staff development activities. There are no human risks associated with this research.

**PROCEDURE**

Observations of teacher questioning strategies will be conducted at elementary school sites. Participation will be voluntary. Participants will be requested to complete a questionnaire providing demographic information on the participants. Observations will be recorded by the teacher and the investigator through the use of written field notes and data collection forms. Teachers may refuse to answer any question on the interview form, and have the right to review the final data. No names or identifying data will be included in this study.

**OTHER INFORMATION**

Data, including demographic data, will be confidential, coded and available only to the researcher. Data will be kept and secured indefinitely and used for the purpose of this research study by the named investigator only. Teachers may refuse to participate or may withdraw at any time up to the end of the study with no fear of reprisal. There are no anticipated risks, stress or discomfort that will occur as a result of participation in this process. This study will occur from September 1, 2000 to December 30, 2000.

This project has been reviewed and approved by the Seton Hall University Institutional Review Board for Human Subjects Research. The IRB believes that the research procedures adequately safeguard the subject's privacy, welfare, civil liberties, and rights. The Chairperson of the IRB may be reached through the Office of Grants and Research Services. The telephone number of the Office is (973) 275-2974.

\_\_\_\_\_  
Signature of Investigator

\_\_\_\_\_  
Date

**Subject's Statement:**

I have read the material above, and any questions I asked have been answered to my satisfaction. I agree to participate in this activity, realizing that I may withdraw without prejudice at any time.

\_\_\_\_\_  
Signature of Participant

\_\_\_\_\_  
Date

Copies to: Participant  
Investigator

Principal Consent Form  
Seton Hall University  
College of Education and Human Services

Investigator: Maryrose Caulfield-Sloan  
A Candidate for the Executive Ed.D.  
Educational Administration and Supervision  
(908)-851-4698

#### PURPOSE AND BENEFITS

This is a research project for a doctoral dissertation in the Executive Ed.D. program of Seton Hall University. This research activity will study the role of higher order questioning strategies used by the classroom teacher as it relates to the assessable performance of students in elementary science. The expected benefits of this study would be a contribution to existing knowledge about elementary science teaching practices and potential implications for future staff development activities.

#### PROCEDURE

Observations will be conducted at elementary school sites. Participation will be voluntary. Teacher participants will be asked to complete a questionnaire providing demographic information. Observations of question asking strategies used by teachers in their classrooms will be recorded by the teacher and the investigator through the use of written field notes and data collection forms. Subjects may refuse to answer any question on the questionnaire form, and have the right to review the final data. No names or identifying data will be included in this study.

The focus of the classroom observations will be on the question-asking strategies of the teacher, not on the students. Data will be obtained from student results on an open-ended science question and this project will occur from September 1, 2000 to December 30, 2000.

#### OTHER INFORMATION

Data will be confidential, coded and available only to the researcher. Data will be kept and secured indefinitely and used for the purpose of this research study by the named investigator only. Participants may refuse to participate or may withdraw at any time up to the end of the study without fear of prejudice or reprisal. There are no anticipated risks, stress or discomfort that will occur as a result of participation in this process.

This project has been reviewed and approved by the Seton Hall University Institutional Review Board for Human Subjects Research. The IRB believes that the research procedures adequately safeguard the subject's privacy, welfare, civil liberties, and rights. The Chairperson of the IRB may be reached through the Office of Grants and Research Services. The telephone number of the Office is (973) 275-2974.

\_\_\_\_\_  
Signature of Investigator

\_\_\_\_\_  
Date

#### Subject's Statement:

I have read the material above, and any questions I asked have been answered to my satisfaction. I agree to participate in this activity, realizing that I may withdraw without prejudice at any time.

\_\_\_\_\_  
Signature of Principal

\_\_\_\_\_  
Date

Copies to: Principal and Investigator

Parent/Guardian Information/Recruitment Letter  
Seton Hall University  
College of Education and Human Services

Investigator: Maryrose Caulfield-Sloan  
A Candidate for the Executive Ed.D.  
Educational Administration and Supervision  
(908)-851-4698

Dear Third Grade Parents/Guardians,

As you may know, I am the Science Specialist for the Township of Union in the elementary schools. I am pursuing a Doctorate in Educational Administration and Supervision from Seton Hall University. This fall I will be conducting research on how third grade teachers ask questions in science. I want to find out if this has an effect on the performance of third grade students.

I will be doing staff development with the third grade teachers in the area of question-asking strategies. I will also be observing the teachers teaching a science lesson in their own classroom for approximately one hour. I will be asking all the third grade students to answer a question about the science lesson that they were taught. I would like to include the results of some of the third grade students on this question in my dissertation.

You may have your child participate in this study if you wish. Participation in this study is purely voluntary and you may decide to withdraw from the study at any time. This will not effect your child's regular science education and the question will not be considered in their grade in science. You may also request the result from your child's answer to this question if you wish.

The results of your child will be kept strictly confidential and no one will have access to this information. No names or identifying information will be included in the dissertation, just group results will be given. I am interested in studying the question-asking methods of teachers and my focus is the teachers, not the students.

If you wish for your child to participate in this study, please sign the enclosed consent form and return it to school with your child. I will send you a copy of this form for your records.

Thank you for your cooperation in this endeavor.

Maryrose Sloan

Parent/Guardian Consent Form  
Seton Hall University  
College of Education and Human Services

Investigator: Maryrose Caulfield-Sloan  
A Candidate for the Executive Ed.D.  
Educational Administration and Supervision  
(908)-851-4698

**PURPOSE AND BENEFITS**

This is a research project for a doctoral dissertation in the Executive Ed.D. program of Seton Hall University. This research activity will study the role of questions used by the classroom teacher and how these questions affect the performance of students in elementary science. The expected benefits of this study would be a contribution to existing knowledge about elementary science teaching practices and potential implications for future staff development activities.

**PROCEDURE**

Observations will be conducted at elementary school sites and participation is voluntary. The focus of the classroom observations will be on the questions asked by the teacher. The focus of the classroom observations is not on the student. Data will come from student responses to a specific science question given by the classroom teacher after the students have received a science lesson by the classroom teacher. This observation will occur for approximately one hour during the student's regular science lesson in the classroom. No names or identifying data will be included in this study.

**OTHER INFORMATION**

Data will be confidential, coded and available only to the researcher. Data will be kept and secured indefinitely and used for the purpose of this research study by the named investigator only. The researcher requests permission to review student demographic data such as I.Q. This information will be known only to the researcher and will be kept coded and confidential to be used only for the purpose of this study. Participants may refuse to participate or may withdraw at any time. There are no anticipated risks, stress or discomfort that will occur as a result of participation in this process. Participants may withdraw from the project at any time up to the end of the project *with out* fear of prejudice or any reprisals. Non-participation in this study will not affect the student's grades in any way.

This project has been reviewed and approved by the Seton Hall University Institutional Review Board for Human Subjects Research. The IRB believes that the research procedures adequately safeguard the subject's privacy, welfare, civil liberties, and rights. The Chairperson of the IRB may be reached through the Office of Grants and Research Services. The telephone number of the Office is (973) 275-2974.

\_\_\_\_\_  
Signature of Investigator

\_\_\_\_\_  
Date

**Parent/Guardian Statement:**

I have read the material above, and any questions I asked have been answered to my satisfaction. I agree to participate in this activity, realizing that I may withdraw without prejudice at any time.

\_\_\_\_\_  
Signature of Parent/Guardian

\_\_\_\_\_  
Date

Copies to: Parent/Guardian  
Investigator

Student Assent Form  
Seton Hall University  
College of Education and Human Services

Investigator: Maryrose Caulfield-Sloan  
A Candidate for the Executive Ed.D.  
Educational Administration and Supervision  
(908)-851-4698

**PURPOSE AND BENEFITS**

This research is being done to study how teachers ask questions about science in their classroom. The problem we want to solve is, "If teachers ask questions, will this help students learn better?" You can be a part of this study. We hope that we can solve this problem and make learning about science better for all students.

**PROCEDURE**

The way that this study will be done is, third grade teachers will learn about asking good questions. Then I will come and watch the teacher teach a science lesson in his or her own classroom to his or her own students. After the lesson, the class will answer a question about what they have been taught. I will check the answers to this question. But, no one else will know what the students said, and no one else will be able to look at these answers. They will be private.

You do not have to be a part of this study if you do not want to. You have the right to say yes or no and you may stop being part of this study at any time if you want to. Nothing in this study will hurt or upset you in any way. This will be about your regular science lessons. We are interested in what the teacher is doing.

A special group of people at Seton Hall University, called the Institutional Review Board for Human Subjects Research has heard all about this study and says that it is okay for me to do this work. This special group, the IRB, is very sure that you cannot be harmed at all and that this project is a good idea. If you want to talk to these people, the person who is in charge of the IRB, he left his phone number so you can call him and check this out. His telephone number is (973) 275-2974.

\_\_\_\_\_  
Signature of Investigator

\_\_\_\_\_  
Date

**Student's Statement:**

I have read this paper and I understand about this project. I asked questions and I want to be a part of this study. I know that I can stop being a part of this study if I want to at any time and no one will be upset with me.

\_\_\_\_\_  
Signature of Student

\_\_\_\_\_  
Date

Copies to: Student  
Investigator